Northern leopard frog, Rana pipiens, *with ordinary spots. This frog was photographed at Silver Lake south of Rutland in Sargent County. The spotting on the back of the frog is the source of the common name of the animal.*

NORTH DAKOTAN NORTHERN LEOPARD FROGS' NEWEST NOTORIETY: They're Polymorphic!

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Photos Provided by the Authors

The common northern leopard frog found in North Dakota, *Rana pipiens*, is recognized by the spots on its upper body surfaces. Most North Dakota leopard frogs are spotted, but some are not. Some leopard frogs have an overlay of mottled pigment patches between their spots. The non-spotted frogs (variants) are known as burnsi morphs and the mottled pigment variants are known as kandiyohi morphs. The presence of different spot patterns or colors in a population constitutes "polymorphism" which simply means the occurrence of something in several distinct forms.

Polymorphism refers to non-blending variants in a population. They are either burnsi, kandiyohi or ordinary spotted frogs, and thus leopard frog populations where burnsi and kandiyohi exist are polymorphic.

Leopard frogs in Minnesota are similarly polymorphic. In fact, most authorities will state that the polymorphic forms are found primarily in Minnesota.

It is true that more counties in Minnesota have burnsi and kandiyohi frogs than counties in North Dakota, and their original scientific description was based on frogs captured in Minnesota. Yet, we believe that much can be learned from studying the distribution of these forms in North Dakota. We know that burnsi, for instance, is found in only La Moure, Dickey, Barnes, Ransom, Sargent and Richland counties. In contrast, burnsi frogs are found in 45 counties of Minnesota. There is a similar situation with regard to the kandiyohi morph which is found in only three North Dakota counties (McIntosh, Cass and Richland) in contrast to 18 Minnesota counties. More of kandiyohi later.

Why might North Dakota, with its limited distribution of burnsi, be an interesting place to study the morph? For the very reason that it is found only in six counties – and all six of those counties are in southeast North Dakota. If ordinary (spotted) leopard frogs are found in all North Dakota counties (see *North Dakota OUTDOORS*, July 1992), why is the burnsi frog found in only six? What is different about these six southeast counties from the counties to the west and north? A curious high school student might ask: How do you know that burnsi does not occur farther west or north? Quite simply, we don't know. While we know where burnsi occur, we cannot state, with complete assurance, where they do not occur. After having examined literally thousands of North Dakota frogs outside of the known distribution of burnsi, we have not found the burnsi morph in collections made in Burleigh, Emmons, Logan, Cass, McIntosh, Burke, Traill and Sheridan counties.

Burnsi morph of the northern leopard frog, Rana pipiens. *Burnsi frogs are devoid of spots on the upper body surface. This adult burnsi frog was collected at Silver Lake south of Rutland in Sargent County.*

Again let us heed the North Dakota high school student who regularly sees only a few frogs in the spring, or scattered frogs in summer. That student may express skepticism that two Minnesota biologists could come to North Dakota and examine "thousands" of frogs and wonder where we find so many.

We do not seek frogs on a pretty day in June, or the 4th of July or even some nice August day. We wait until mid-September or later to begin our collections. By that time, the natural instinct of this frog species is to return to a reasonably deep lake that will not freeze solid and that has enough oxygen for survival during the rigorous North Dakota winter. Frogs will congregate near the margins of these overwintering lakes as the days grow shorter and as temperatures drop. We know that they are most vulnerable to our nets just prior to overwintering and seek them at that time. We capture frogs with a net, put them in cloth bags, and when we have enough (which really means when we get exhausted), we sit down with a notebook and ruler and record the catch. We release the frogs on site after data is entered in the notebook. Generally after release, the frogs sit around for a few minutes before they hop away. We collect just prior to overwintering because it is a time that we can obtain large numbers of frogs. When studying polymorphism a large sample is necessary because the frequency of burnsi and kandiyohi rarely exceeds 5 percent and is often lower than 1 percent.

Back to the question of not finding pigment-pattern morphs in counties to the west and north of known locations. While it is true that we have collected and released thousands of frogs and have not seen the elusive morphs at locations other than the six counties shown on our map, perhaps we would have found a burnsi had we collected just a few more at a particular site. Confirming a negative finding (the lack of a particular type of frog) is far more difficult than reporting a positive finding (the presence of burnsi or kandiyohi). Thus we are not absolutely certain that the froggy morphs are missing from the counties where we failed to find them.

Why is North Dakota important for the study of the distribution of these variant frogs? Northern leopard frogs are found in New England to the Rocky Mountains and into much of the southwest. They are also found in Canada adjacent to sites where they are found in the United States. This is an area larger than all of Europe. While conditions permitting survival of the species are adequate throughout its range, burnsi and kandiyohi are found in a much more limited locale. North Dakota seems to form the northwest limit of distribution.

We ask why it is that the burnsi range stops abruptly where it does and we have no suitable answer. Stutsman County to the immediate northwest of the known distribution is a hospitable place for northern leopard frogs. Yet, despite collecting 1,082 leopard frogs in that county over several years and at several sites, no burnsi have been seen.

We have collected burnsi at Silver Lake in Sargent County in three separate years – each time we found the spotless morph. Compare that with Hoffer Lake Recreation Area just north of McClusky in Sheridan County where there are frogs galore, but no burnsi were observed. We do NOT understand why burnsi or kandiyohi suddenly stop in southeastern North Dakota yet the remainder of the state is hospitable to spotted leopard frogs. We do not understand why biological, geological or other ecological factors would affect frogs with a variant pigment pattern when these changes seem not to affect the spotted leopard frog.

There is an alternative explanation that has little or nothing to do with ecological considerations. It could be that the two mutations affecting pigment pattern occurred in the distant past in Minnesota or North Dakota and slowly spread. Frogs can hop several miles in their annual feeding, breeding, and overwintering migrations. That could account for some extension of the range.

Water birds foraging in a breeding pond could carry the eggs on their legs or feathers to other ponds. If the eggs came from the mating of a burnsi or kandiyohi, the pond would host not only the common spotted frog but some of the pigment-pattern morphs as well. This could account for much of the distribution that we have observed – in other words, the sites where burnsi frogs are found could relate to a mutation from spotted to spotless that occurred perhaps thousands of years ago. What we observe now could be the mutant progeny of that far distant event that have slowly spread to the counties where they have been observed.

Map showing North Dakota counties with populations of frogs with the burnsi (gray) or the kandiyohi (oblique lines) morphs. The known distribution of burnsi frogs is shown in the upper insert map. Lower insert map is of the known distribution of kandiyohi frogs.

Kandiyohi morph of the northern leopard frog, Rana pipiens. *Kandiyohi frogs have pigment patches (mottling) between spots on their upper body surface. This juvenile kandiyohi frog was one of a collection of eight juvenile and adult kandiyohi frogs collected at Coldwater Lake in McIntosh County. Coldwater Lake is the most western site recorded thus far for this morph.*

Let us add a note here about the kandiyohi morph. It is known to occur even farther west than burnsi. And, there is a strikingly interesting aspect of the kandiyohi distribution. Its known western limit is a distribution "island" near Coldwater Lake in McIntosh County more than 100 miles to the west of where kandiyohi were observed in Richland County. We have questions concerning this odd range. Are there no geographically intermediate populations of kandiyohi that link it with other kandiyohi morphs? If so, why? Does the site in McIntosh county have something special that is lacking in Dickey and Sargent counties and if so, what is it?

Burnsi and kandiyohi were referred to earlier as morphs – here we speculate that they are progeny of a mutational event. In fact, many biologists refer to the morphs as the "burnsi mutant" and "kandiyohi mutant." A mutation is a change in the genetic material of an organism. Both burnsi and kandiyohi differ from common spotted leopard frogs by single dominant genes. That is, burnsi has a one gene difference from the common frog. This is true also of kandiyohi. The burnsi gene results in a frog that is so strikingly different from ordinary spotted frogs that the burnsi frog was originally described as a new species. After all, it was discontinuous from other frogs. And similarly, kandiyohi was initially described as a new species. It, too, was discontinuous or failed to blend with spotted frogs. The single gene genetic difference was discovered in breeding experiments of the morphs. As a matter of historical note, the breeding experiments were carried out at Columbia University in New York City – a long way indeed from southeast North Dakota.

Let us now return to that bright and curious high school student, or other interested North Dakota citizens for that matter, and challenge the curious to look at the distribution map of these frogs in North Dakota. Perhaps a timely observation can help the scientific community understand more about the geographic distribution of these interesting morphs.

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